IN THE DRAWINGS

New Figure 6 is enclosed herewith.

REMARKS

Claims 1-33 are pending in this application.

Withdrawn Claims 12-21 have been cancelled without prejudice to applicants' right to file a separate divisional application to the subject matter embodied therein. The Office Action states that previously presented claims 30 and 31 have been also withdrawn for being dependent upon withdrawn claim 12. Inadvertently, the dependencies of claims 30 and 31 on withdrawn claim 12 were typographic errors; the dependencies should have been on claim 22, as now correctly set forth in currently amended claims 30 and 31. As such, reconsideration of currently amended claims 30 and 31 as being includable with elected Claims 1-11, 22-29, 32 and 33, is respectfully requested.

New claims 34 and 35 have been added. These claims are directed to the infrared filter of the elected Claims 1-11 and 22-33, and are believed to be properly includable with the elected claims.

The drawings have been objected to under 37 CFR 1.83(a) for failing to show every feature of the invention specified in the claims. In an effort to obviate this objection, a new Fig. 6 has been added by way of the appended drawing sheet. Also, associated brief and detailed descriptions of Figure 6 have been added to the specification by way of respective paragraphs [0028.1] and [0058.1]. Figure 6 shows a simplified cross-section of an IR blocking filter according to an embodiment of the present invention, wherein some of the corrosion suppressing layers are deposited in two portions.

In particular, Figure 6 clearly shows the second corrosion-suppressing layer including a metal portion on the metal layer and a metal-oxide portion on the metal portion as defined in claim 32. Support for Figure 6 is provided in claim 32, and in paragraphs [0029] to [0033] and paragraph [0058] of the original specification, as filed.

The disclosure was objected to for various informalities. The specification has been amended to fill in the blanks in paragraph [0001] and to correct the reference number 44 to 28 in paragraph [0031].

Claims 1-4, 8 and 10 have been rejected under 35 USC 102(b) as being anticipated by Braatz et al. In an effort to obviate this rejection, Claim 1 has been amended to specify that the plurality of metal layers comprises at least four metal layers. Braatz et al do not teach an infrared filter having a plurality of metal layers alternating with a plurality of dielectric layers, wherein the plurality of metal layers includes at least four metal layers. Also, Braatz et al do not teach such an infrared filter as obtaining an average transmission greater than or equal to 75% between 400 nm and 600 nm. Braatz et al discuss providing only two metal layers (Fig. 1). Accordingly, amended claim 1, and claims 2-11 and 22-34, which depend from amended claim 1, are believed to be patentable.

Support and advantage(s) for providing an infrared filter having a plurality of metal layers alternating with a plurality of dielectric layers, wherein the plurality of metal layers includes at least four metal layers, and wherein the infrared filter obtains an average transmission greater than

or equal to 75% between 400 nm and 600 nm, as set forth in the currently amended claims 1-11 and 13-33 and in newly added claims 34 and 35, are as follows.

Referring to paragraph [0036] of the application as filed, increasing the number of metal layers increases the steepness of the transition between the passband and the blocked wavelengths. As is evident from Fig. 2A to Fig. 4, a steep transition allows more of the unwanted radiation (e.g., near-infrared) to be filtered out. However, as also discussed in paragraph [0036], increasing the number of metal layers decreases the average transmission. Accordingly, the number of metal layers will determine the balance between a steep transition and good average transmission.

Applicants have found that an optical design with three layers has a relatively shallow transition, but a high average transmission, while an optical design with six layers has a steep transition, but low average transmission. Optical designs with four to five layers were found to provide both good average transmission and a relatively steep transition. For example, Figs. 3b and 3c illustrate that optical designs with four metal layers will filter out most of the near-infrared radiation, while still providing an average transmission greater than 75% in the visible region.

Since most of the near-infrared radiation is filtered out, these IR filters advantageously provide an increased signal-to-noise ratio when used with an image sensor, as for example, found in digital still cameras, vidoeo cameras, and/or camphones. Furthermore, as discussed in paragraph [0056] of the present application, the relatively high average

transmission may allow these IR filters to be advantageously used in place of color glass filters in various applications.

Referring to paragraphs [0040] to [0043] of the present specification, another advantage of the filter defined in amended claim 1 is that the angle shift with angle of incidence is smaller than for all-dielectric IR blocking filters and that no discernable half-wave hole appears with non-normal angles of incidence. It is respectfully submitted that none of the prior art recognizes that an infrared filter having at least four metal layers will provide an average transmission greater than or equal to 75% between 400 nm and 600 nm and/or with a reduced wavelength shift with angle of incidence.

Claims 1,4,5,8, and 10 have been rejected under 35 USC 102(b) as being anticipated by Pass et al. This rejection is respectfully traversed. In particular, it is submitted that Pass et al do not teach an infrared filter having a plurality of metal layers, wherein the filter obtains an average transmission greater than or equal to 75% between 400 nm and 600 nm. The transmission spectra of Figure 6 of Pass et al are for coating structures having only one metal layer (e.g., IO/M/ITO or IO/M/IO/IO or IO/M/IO/ITO), not a plurality of metal layers. According, Pass et al do not teach every element of the invention as defined in claim 1, and hence do not anticipate rejected claim 1 and/or rejected claims 4,5,8 and 10, which depend from claim 1.

It is further submitted that Pass et al do not teach the invention as defined in amended claim 1, and hence claims 2-11 and 22-34, which depend from amended claim 1, for the reasons

discussed above (i.e., Pass et al do not teach an infrared filter having a plurality of metal layers alternating with a plurality of dielectric layers, wherein the plurality of metal layers includes at least four metal layers, and wherein the infrared filter obtains an average transmission greater than or equal to 75% between 400 nm and 600 nm).

Claims 9 and 11 have been rejected under 35 USC 103(a) has being unpatentable over Speier et al in view of Braatz et al and over Speier et al in view of Pass et al. These rejections are respectfully traversed.

In particular, it is submitted that it would not be obvious to replace the filter of Speier et al with the low-e coating described in either Braatz et al or Pass et al. While these low-e coatings may achieve high transmission in the visible range and prevent some damaging IR rays, they also allow a significant amount of near-infrared radiation to pass through. As discussed above, the transmission of near-infrared radiation is related to very shallow passbands transitions resulting from the low number of metal layers (i.e., less than three). Since low-e coatings allow a significant amount of near-infrared radiation to pass through, the image sensor in Speier et al would suffer from a lower signal-to-noise ratio. It is submitted that it would not be obvious to replace the IR filter used in Speier et al with a less effective IR filter.

It is further submitted that there is no motivation to combine the teachings of either Braatz et al or Pass et al with those of Speier et al. In fact, both Braatz et al and Pass et al discuss only applications where bandpass criteria

are unimportant (i.e., as low-e coatings). Withdrawal of the rejections of claims 9 and 11 is respectfully requested.

Claims 22, 23, 25-26, and 29 have been rejected under 35 USC 103(a) as being unpatentable over Braatz et al in view of Ebisawa et al. This rejection is respectfully traversed.

In particular, it is submitted that it would not have been obvious to add a second corrosion-suppressing layer of Ebisawa et al to the system of Braatz et al to make it of the form D1/C1/M1/C2/D2. According to the Summary of the Invention, Braatz et al aim for a low-e coating with a light transmission equal to or greater than 79%. Referring to the table in column 3, Braatz et al achieve a light transmission equal to 78% using a blocker (corrosion-suppressing layer) and 80% without the blocker. It would not be obvious to add additional blocker layers to the optical design taught in Braatz et al, as such an addition would further reduce light transmission. Withdrawal of the rejection of claims 22, 23, 25, 26 and 29 is respectfully requested.

Claims 6-7, 22-29, and 32 have been rejected under 35 USC 103(a) as being unpatentable over Pass et al in view of Ebisawa et al. This rejection is respectfully traversed.

As pointed out above, Pass et al do not teach an infrared filter having a plurality of metal layers, wherein the filter obtains an average transmission greater than or equal to 75% between 400 nm and 600 nm. The transmission spectra shown in Fiugre 6 of Pass et al are for coating structures having only one metal layer (e.g., IO/M/ITO or IO/M/IO/IO or IO/M/IO/ITO) not a plurality of metal layers. Accordingly, it is submitted

that the proposed combination of teachings does not result in the invention as defined in claims 6-7, 22-29, and 32. Withdrawal of the rejection is respectfully requested.

It is further submitted that it would not be obvious to employ the corrosion-suppressing layers of Ebisawa et al in the system of Pass et al to obtain an infrared filter having at least four metal layers alternating with a plurality of dielectric layers with an average transmission greater than or equal to 75% between 400 nm and 600 nm. In fact, the average transmission is discussed with reference to only one or two metal layers.

Claim 33 has been rejected under 35 USC 103(a) as being unpatentable over Braatz et al in view of Miyakzaki and over Pass et al inview of Miyazaki et al. This rejection is respectfully traversed.

Claim 33 has been amended to replace "optical filter" with "infrared filter", to correct for a lack of antecedent basis. Since claim 33 is dependent on amended claim 1, which is believed to be allowable, claim 33 is also now believed to be allowable.

Claim 1 has been further amended to remove the inclusion of a transmission-enhancing coating (which is optional, but not necessary). An example of support for this amendment is provided in paragraphs [0033] and [0060], where it is specified that the AR coating is optional. No new matter has been added.

Claim 8 has been amended to specify that the infrared filter includes a transmission-enhancing coating disposed on a second surface of the substrate, wherein the transmission-enhancing coating is an anti-reflective coating. An example of support for this amendment is provided in paragraphs [0033] and [0060]. No new matter has been added.

Claim 9 has been amended to specify that the infrared filter includes a transmission-enhancing coating and a blur filter, the blur filter disposed between the transmission-enhancing coating and a second surface of the substrate. An example of support for this amendment is provided in paragraphs [0038] and [0039]. No new matter has been added.

New claim 34, which depends upon amended claim 1, has been added. New claim 34 specifies that the infrared filter has a relatively low wavelength shift with angle of incidence. Support for this amendment is provided in paragraphs [0041] and [0043], as filed. No new matter has been added.

Clearly, none of the references teach providing an optical filter stack including a plurality of dielectric layers and a plurality of metal layers alternating with the dielectric layers, wherein the infrared filter has a relatively low wavelength shift with angle of incidence. An infrared filter with a relatively low wavelength shift with angle of incidence provides the unobvious advantage of being useful for shielding charge-coupled diode ("CCD") and complementary metal-oxide-semiconductor ("CMOS") image sensors from infrared radiation.

Finally, new independent claim 35 has been added. Claim 35 includes features recited in original claims 1 and 11. No new matter was added. Claim 11, which depends from claim 1, was rejected under 35 USC 103a as being upatentable over Speier et al in view of Braatz et al and over Speier et al in view of Pass et al. As pointed out above, it would not be obvious to replace the IR filter of Speier et al with the low-e coating described in either Braatz et al or Pass et al. IR filters for use with image sensors, as for example used in digital still cameras, vidoeo cameras, camphones and/or the endoscope discussed in Speier et al, have very stringent requirements.

As discussed in paragraph [0036] of the present specification, it is desirable for these IR filters to have good transmission in the passband, and a sufficiently steep transition from the passband to the blocked wavelengths. While the low-e coatings disclosed by Both Braatz et al and Pass et al appear to provide good transmission in the visible range, the increased transmission is achieved by limiting the number of metal layers to two or less. As discussed above and as is known to those skilled in the art, low-e coatings manufactured with two or less metal layers do not exhibit sharply defined transmission bands, and there is no suggestion that such a filter would obtain an average transmission greater than or equal to 75% between 400 nm and 600 nm, as claimed in claim 35. Namely, while the prior art filters are suitable for use in heat reflective window glazings and/or filters for placement in front of a CRT, they allow too much near-infrared radiation to pass to be useful in reducing the noise level in an image sensor.

As discussed in paragraphs [0011] to [0013] of the present specification, it is also desirable for these IR filters to exhibit minimal wavelength shift (e.g., the cut-off wavelength) with angle of incidence. As discussed above, the low-e coatings disclosed by Both Braatz et al and Pass et al do not exhibit sharp transition bands. Accordingly, discussing wavelength shift with angle of incidence for these low-e coatings is futile.

It is respectfully submitted that it would not be obvious to replace the IR filter disclosed in Speier et al with the low-e coatings disclosed in either of Braatz et al or Pass et al, since they do not meet the strict bandpass specifications for IR filters used with image sensors and would increase the noise level of the image sensor. It is further submitted that there is no motivation to combine the teachings of either Braatz et al or Pass et al with those of Speier et al. As such, claim 35 is believed to be patentable.

In view of the foregoing amendments and remarks, it is respectfully submitted that the instant application is now in condition for allowance.

Early and favorable reconsideration of the Examiner's objections would be appreciated.

Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

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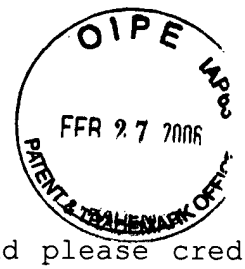

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